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(72) Inventors; and

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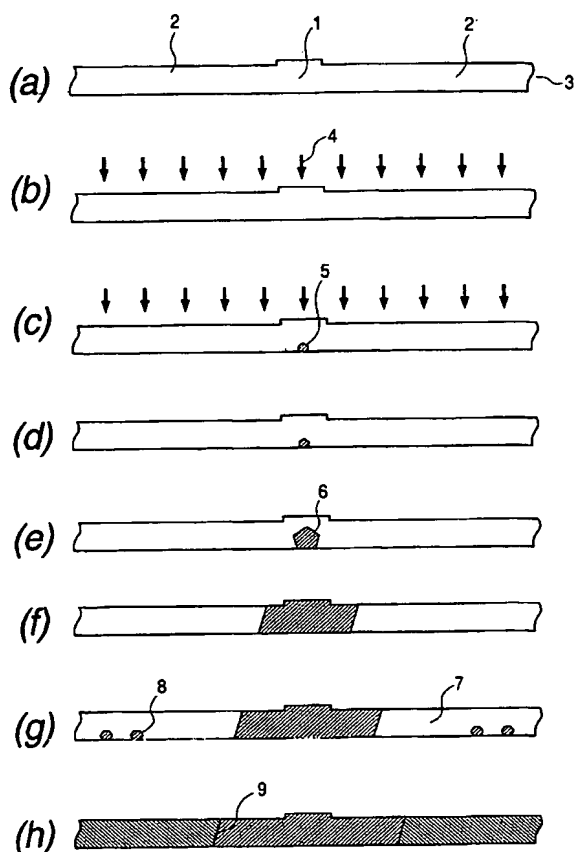
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[Continued on next page]

(54) Title: PRODUCING METHOD FOR CRYSTALLINE THIN FILM



(57) Abstract: A method for producing a crystalline film by melting and resolidifying a film, characterized in preparing a film having a specific region and obtained either by (A) a step of forming a film in which a "specific region" and an "region continuous to a periphery of the specific region and different in thickness from the specific region" co-exist, or by (B) a step of irradiating a film with an electromagnetic wave or particles having a mass in mutually different conditions between a specific region and a peripheral region thereof, and melting and resolidifying at least a part of the film. As the spatial position of the specific region can be exactly and easily controlled, it is possible to obtain a crystalline film in which a crystal grain is formed in a desired position.



(81) **Designated States (national):** AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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INTERNATIONAL SEARCH REPORT

Int. Application No.

PC 03/15072

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H01L21/20 C30B13/00 C30B29/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H01L C30B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WILT VAN DER P CH ET AL: "GRAIN LOCATION CONTROL IN EXCIMER-LASER CRYSTALLIZATION OF THIN SILICON FILMS" PHYSICA STATUS SOLIDI (A). APPLIED RESEARCH, BERLIN, DE, vol. 166, no. 2, April 1998 (1998-04), pages 619-627, XP000933738 ISSN: 0031-8965 2. Experimental and Results	1-9, 31-45
X	WO 89/04550 A (KOPIN CORP) 18 May 1989 (1989-05-18) page 8, line 14 - page 12, line 10; figures 2-5 ----- -/-	1-9, 31-45



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

* Special categories of cited documents:

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

International Application No

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 670 088 A (TSAUR BOR-YEU ET AL) 2 June 1987 (1987-06-02) column 5, line 43 - column 6, line 42; claims 1-17; figures 2A-2D	1-9, 31-45
A	HATANO M ET AL: "In situ and ex situ diagnostics on melting and resolidification dynamics of amorphous and polycrystalline silicon thin films during excimer laser annealing" JOURNAL OF NON-CRYSTALLINE SOLIDS, NORTH-HOLLAND PUBLISHING COMPANY, AMSTERDAM, NL, vol. 266-269, May 2000 (2000-05), pages 654-658, XP004198583 ISSN: 0022-3093 the whole document	1-9, 31-45
X,P	EP 1 262 578 A (CANON KK) 4 December 2002 (2002-12-04) examples 5-12	1,5-45
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X	HIDEYA KUMOMI ET AL: "MANIPULATION OF NUCLEATION SITES IN SOLID-STATE SI CRYSTALLIZATION" APPLIED PHYSICS LETTERS, AMERICAN INSTITUTE OF PHYSICS. NEW YORK, US, vol. 59, no. 27, 30 December 1991 (1991-12-30), pages 3565-3567, XP000257094 ISSN: 0003-6951 page 3565, left-hand column, line 33 - page 3566, left-hand column, line 20	1,5-45
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INTERNATIONAL SEARCH REPORT

In International Application No
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 338 342 A (LG PHILIPS LCD CO LTD ; LG LCD INC (KR)) 15 December 1999 (1999-12-15) claims 1-21	1,5-45
X	PATENT ABSTRACTS OF JAPAN vol. 0080, no. 52 (C-213), 9 March 1984 (1984-03-09) & JP 58 208197 A (TOKYO SHIBAURA DENKI KK), 3 December 1983 (1983-12-03) abstract	1,5-45
X	US 5 496 768 A (KUDO TOSHIO) 5 March 1996 (1996-03-05) claims 1-17	1,5-45
X	KURIYAMA H ET AL: "COMPREHENSIVE STUDY OF LATERAL GRAIN GROWTH IN POLY-SI FILMS BY EXCIMER LASER ANNEALING AND ITS APPLICATION TO THIN FILM TRANSISTORS" JAPANESE JOURNAL OF APPLIED PHYSICS, PUBLICATION OFFICE JAPANESE JOURNAL OF APPLIED PHYSICS. TOKYO, JP, vol. 33, no. 10, PART 1, 1 October 1994 (1994-10-01), pages 5657-5662, XP000596958 ISSN: 0021-4922 page 5657, right-hand column, last line - page 5658, left-hand column, line 32	1,5-45
X	US 4 564 403 A (SAWADA AKASHI ET AL) 14 January 1986 (1986-01-14) claims 1-8	46-48

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP 03/15072

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-9,31-45

A method comprising a specific region obtained by forming a film in which a "specific region" and an "region continuous to a periphery of the specific region and different in thickness from the specific region" co-exist.

2. claims: 1,5-45

A method comprising a specific region obtained by irradiating a film with an electromagnetic wave or particles having a mass in mutually different conditions in a specific region and in a peripheral region.

3. claims: 46-48

A method for producing a crystalline film characterized by the step of melting-resolidification of a film

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inventor's Application No

PCT/JP 03/15072

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